

How Does a Floodplain Function?

No Adverse Impacts

Preserving our Watersheds

Protecting Our Property Rights



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Setting the Stage

Physical Processes Associated with Floodplain Environments

- Hydrologic
 - Flooding
 - Groundwater
- Geomorphic
 - Sediment Cycling
 - Channel Migration
- Influences Affecting Process
 - Land Use/Encroachment
 - Beaver Eradication
 - Climate
 - Disturbance (eg Ice Jamming)

Flathead



Other Important Processes

- Water Quality
- Biological Diversity/Habitat Complexity
- Soils Development



A floodplain is flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding.

San Antonio River



Owens River



Cataract Canyon



Little Big Horn



Bedrock Control

Narrow Floodplains



Steep Channels/ Headwater Streams

Narrow Floodplains



Upper Nevada Creek



Wise River

High Elevation Meadows

Locally Wide Floodplain



Hayden Valley

BigSkyFishing.com

Typical Constraints

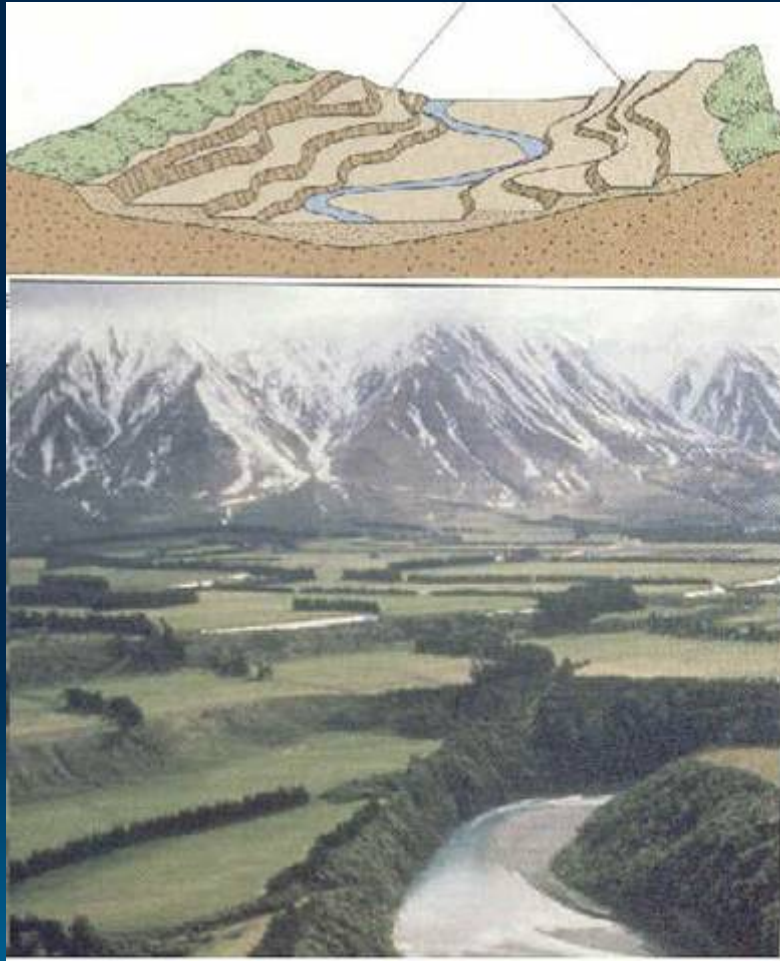
- Channel Stability
- Geologic Controls
- Transportation Encroachment
- Urban Encroachment



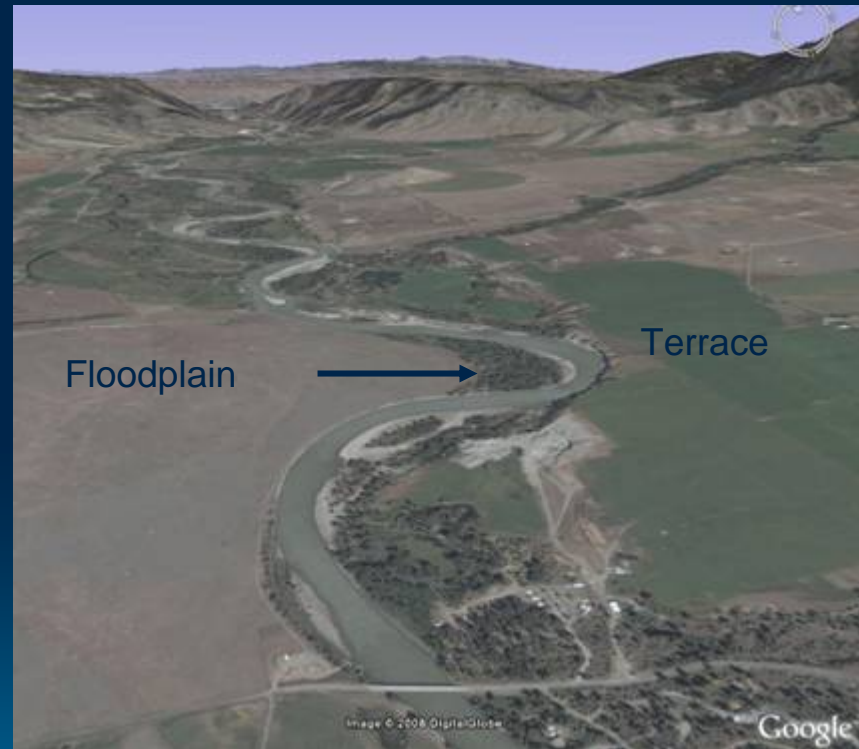
Yellowstone River at Billings

Channel Stability

Terraces are Abandoned Floodplains



New Zealand



*Yellowstone River Above
Livingston*



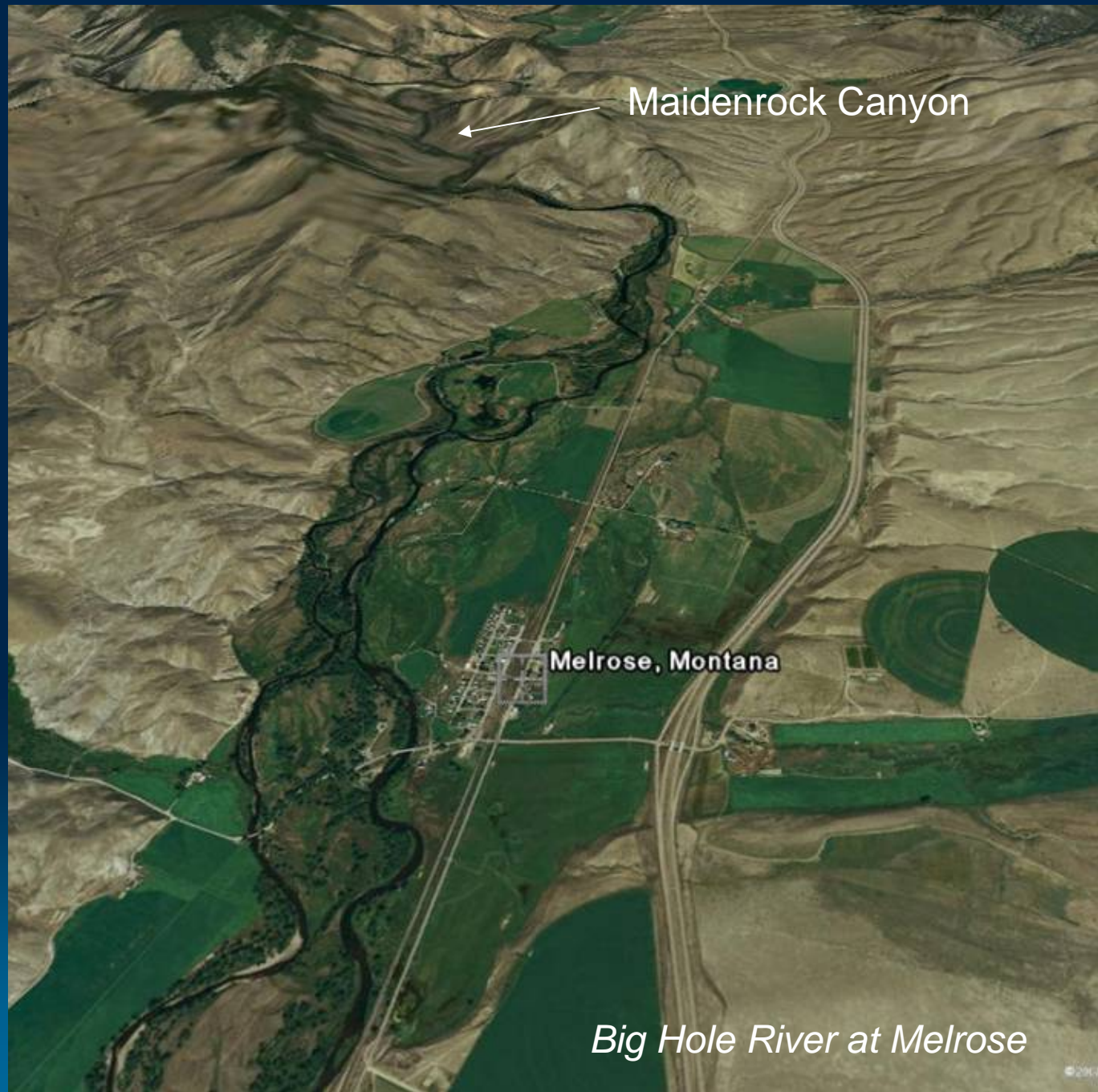
Unstable, Incised Channels Have No Floodplain (for a while)

⇒ Variability in Character

Geology

Stability

Human Impacts



Floodplains and Hydrology



Sacramento River, California

Dampening the Flood Hydrograph



Red River

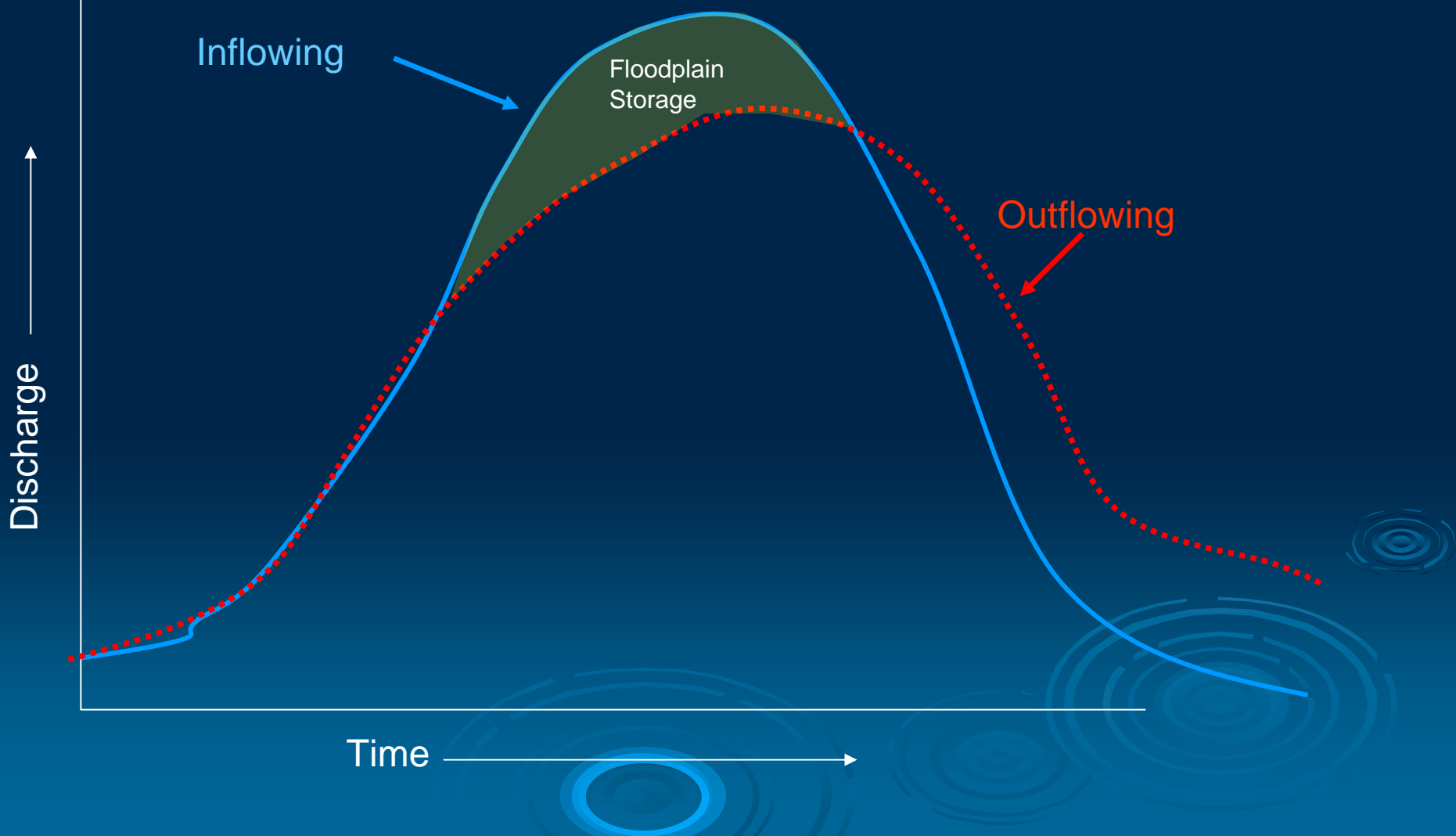
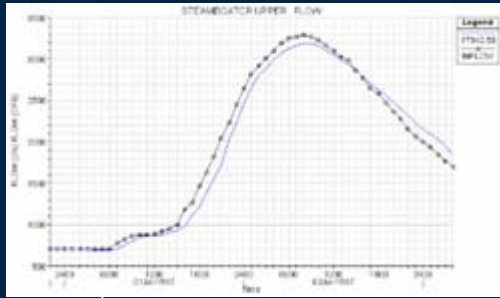


Inflowing



Outflowing

Fraser River 1948



Floodplain Isolation

- Protects areas from flooding, BUT...
- Creates risk of catastrophic flooding
- Delivers more water downstream
- Reduces overbank infiltration/ baseflows
- Reduces water quality



New Orleans

Floodplain Isolation Due to Berms/Levees



Historic
Floodplain

Berm

Silver Bow Creek



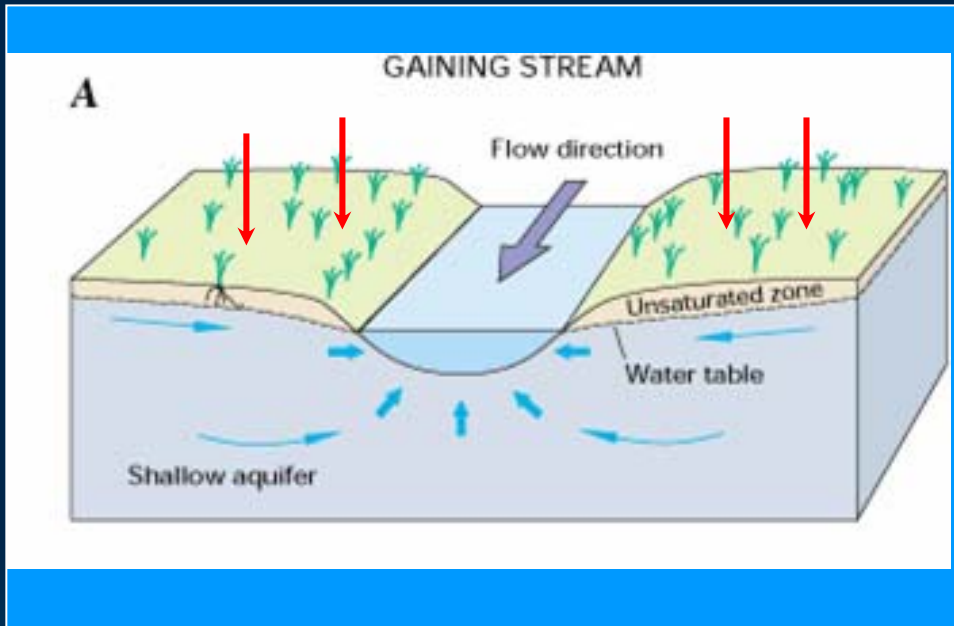
0 0.5 Miles

Floodplain Isolation
Due to
Transportation
Infrastructure



Yellowstone River

Floodplain Infiltration and Base Flows



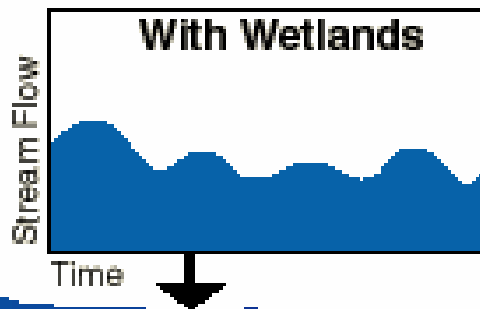
Infiltration of floodwaters into floodplain sediments recharges the shallow aquifer

Base flows increase and peak flows decrease

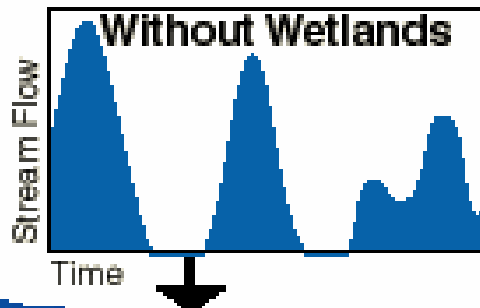
“Hydrologic Buffering”

Floodwater Storage
Groundwater Recharge

Hydrologic Buffering



Diminished
Peaks
Consistent
Baseflow




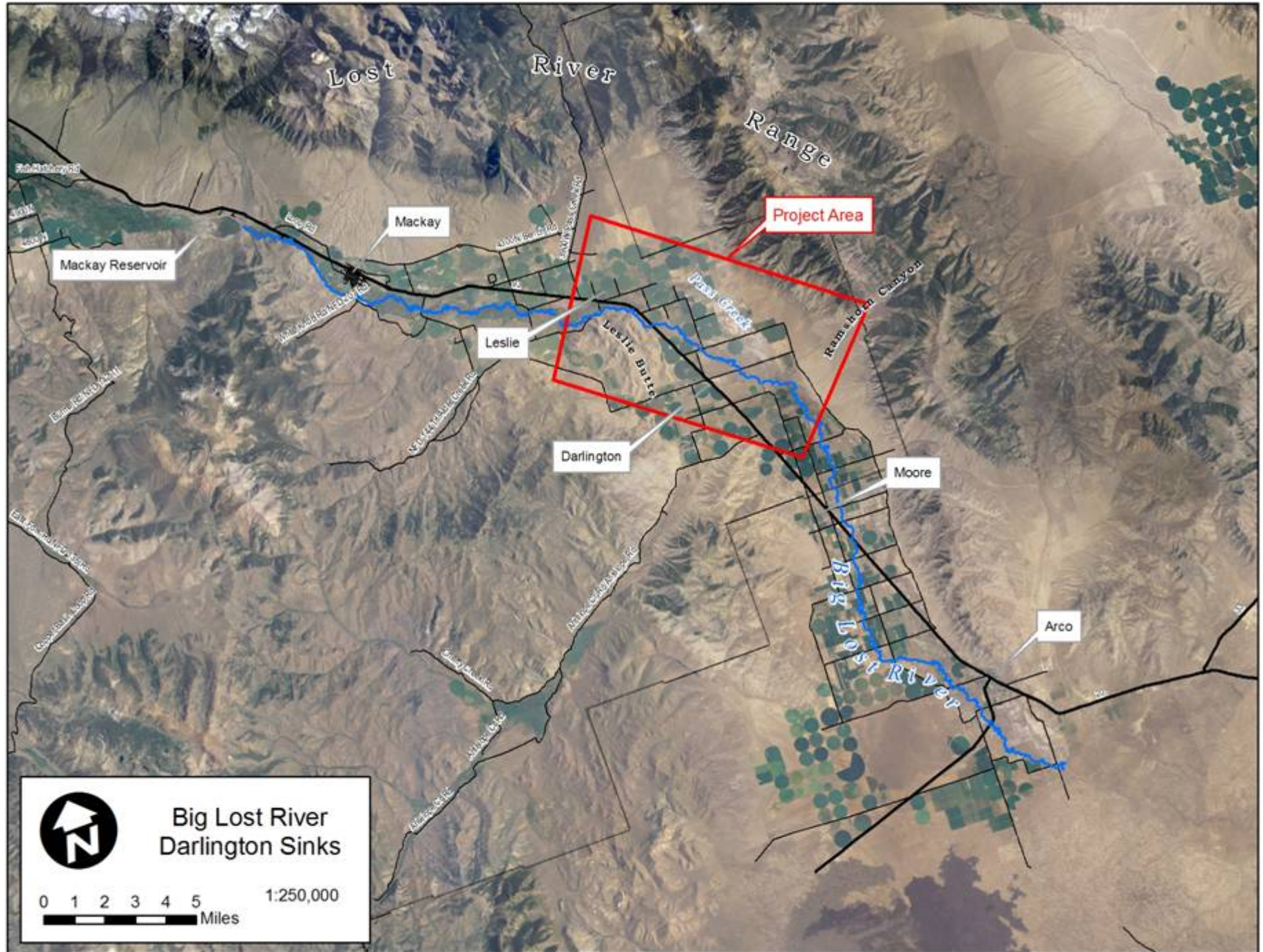
Exaggerated
Peaks (Floods)
Inconsistent
Baseflow
(Drought)

Based on BSC Group

What About Floodplain Irrigation Practices?

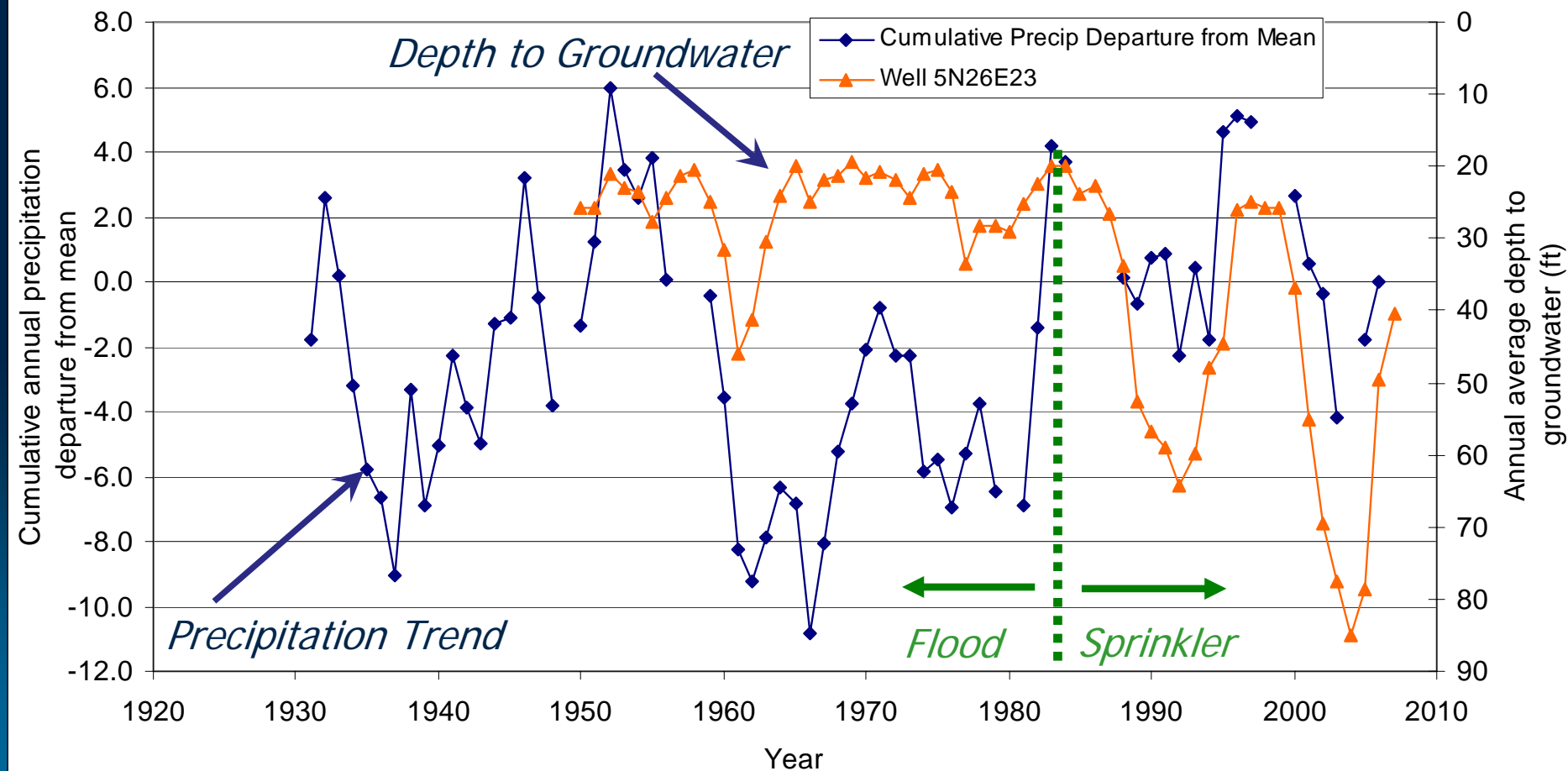
Big Lost River Idaho

- Extensive Flood Irrigation Prior to Mid-80s
 - Conversion to Sprinkler Mid-80's
 - ➔ Increase in Irrigated Acreage
 - ➔ Increase in Groundwater Pumping
 - ➔ Drop in Water Table
 - ➔ Increased Climatic Control on Water Availability
 - ➔ Drop in Base Flows
- 

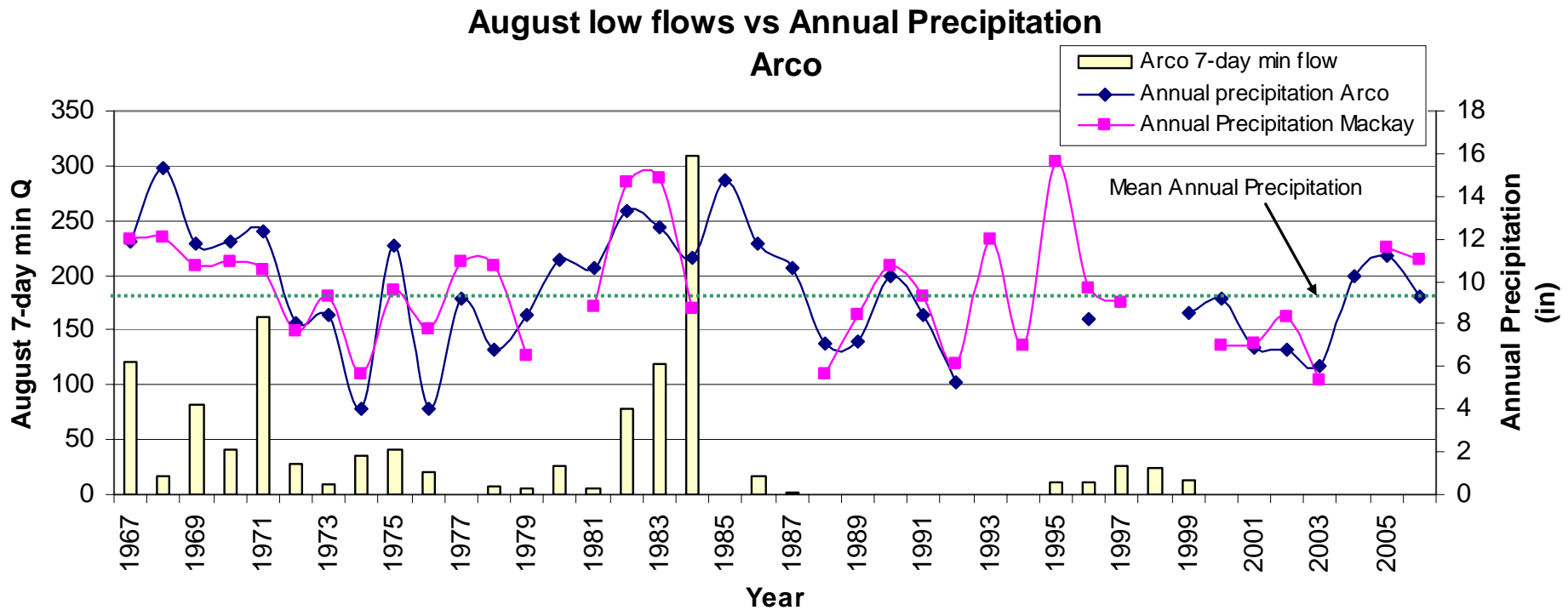


Irrigation, Climate, and Water Table Elevation Big Lost River Idaho

Annual Precipitation Trends and Groundwater Levels



Big Lost River has been going dry at Arco since 1985



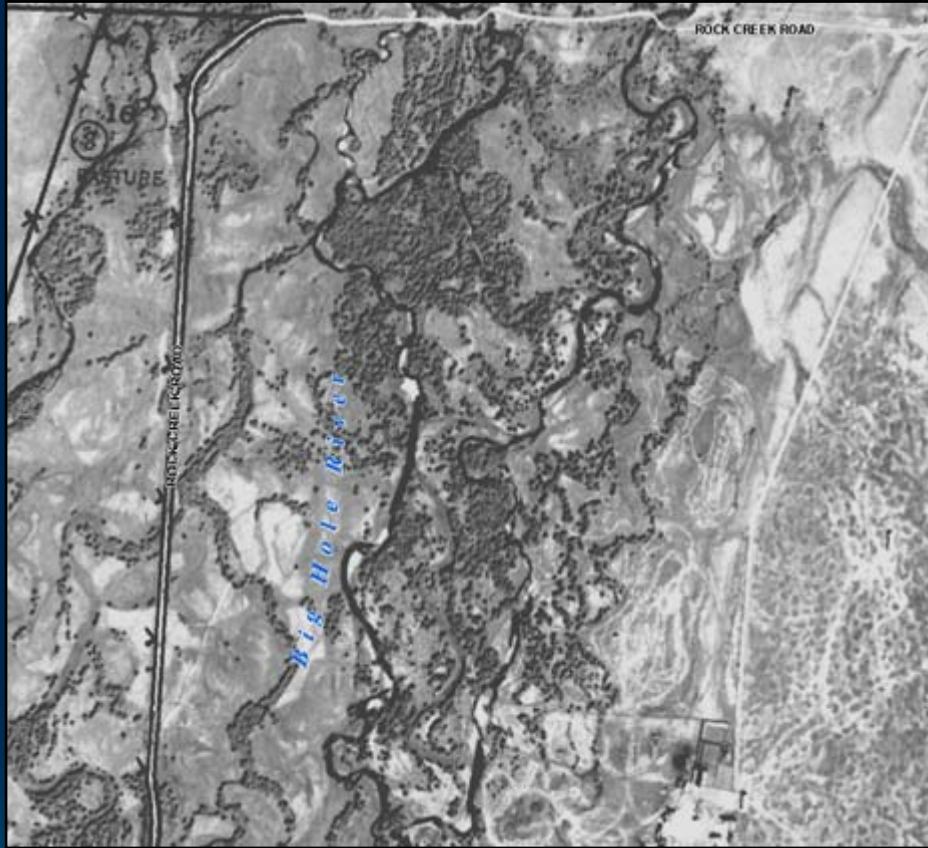
Nature's Flood Irrigators?





There's an ever increasing body of evidence indicating that the beaver trapping era had an enormous impact on our channels and floodplains

1942



1995



Historic Vegetation Patterns

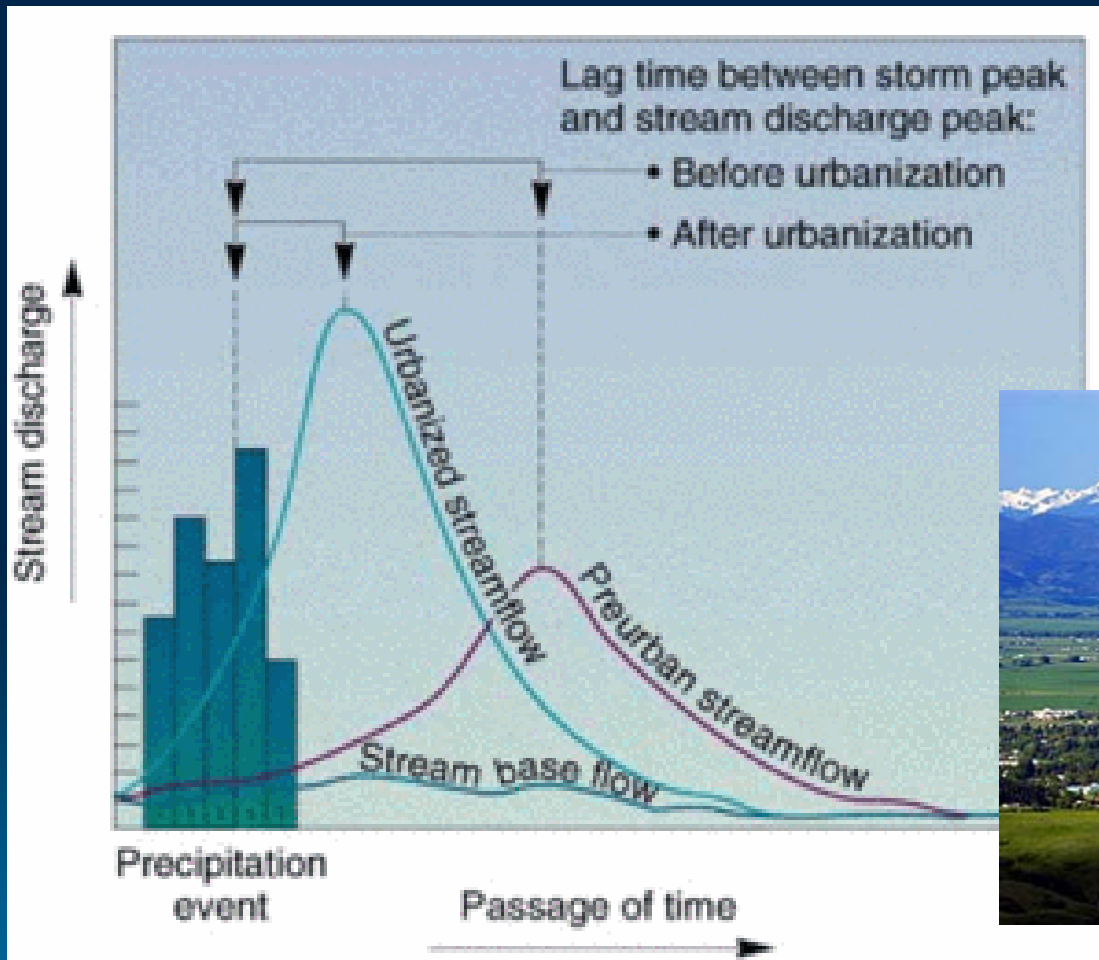
Upper Big Hole

Downcut Channels With Cohesive, Organic Rich Toe



Elk Creek, Lower Blackfoot

Inhibiting Infiltration Through Impervious Surfaces



Floodplain Geomorphology

Sediment Storage/Sorting



Nevada Creek

Building floodplains through “vertical accretion”

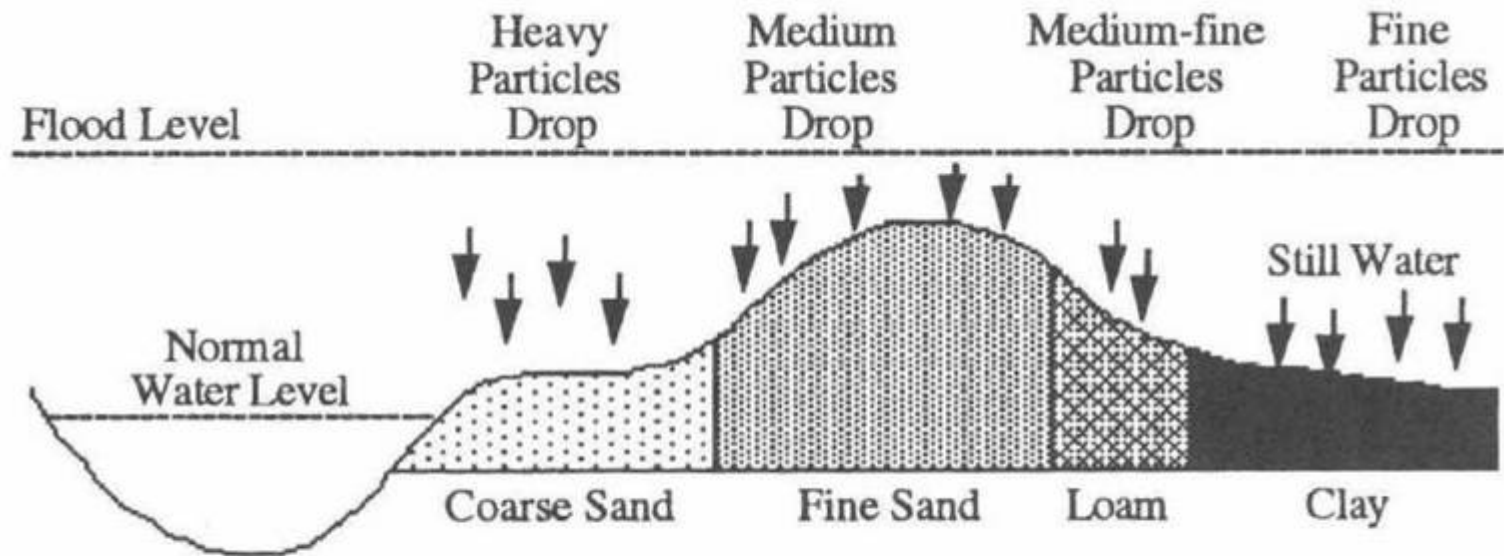


FIGURE 13.3 Depositional patterns in minor floodplains and the relationship to topographic features of the floodplain.

Building floodplains through “lateral accretion” (migration and bar deposition)



An aerial photograph of a river system, likely the Snake River, flowing through a dry, hilly landscape. A blue overlay highlights a specific path or area within the river, indicating a migration route. A red arrow points to a specific location on this path. The surrounding terrain is rugged and arid, with some sparse vegetation and a road visible on the left side.

Migration

Downstream of Emigrant 1948



*New Riparian
Forest*

Lateral Accretion
Creates Floodplain

Downstream of Emigrant 1948, 2005

The result: banks amenable to undercutting,
vegetation colonization, gravel recruitment



Arkansas
River

Channel Migration

Rivers tend to migrate across their floodplains



Map, 1944



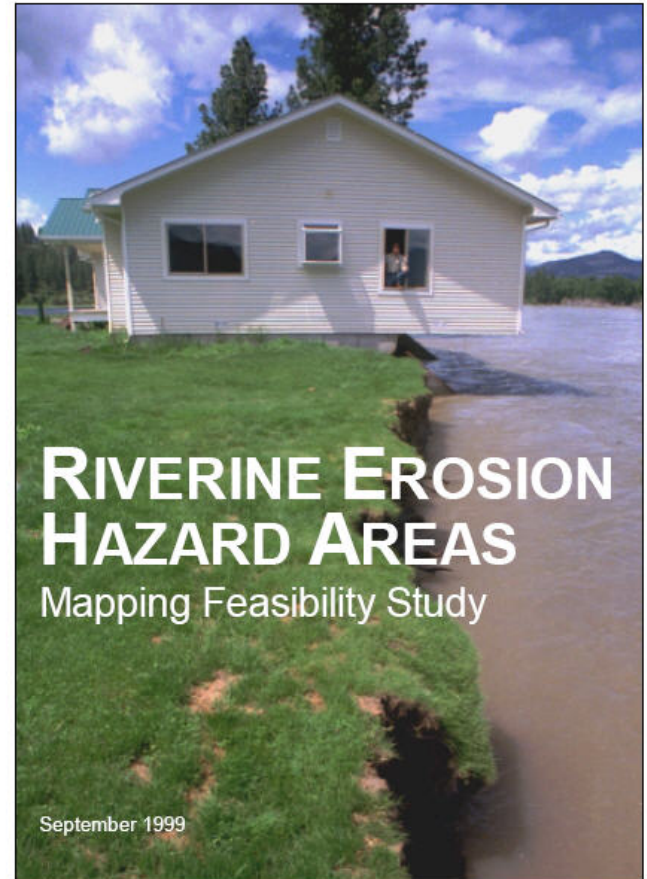
Satellite Image, September 22, 1999

Although migration builds
floodplain, stores and cycles
sediment, creates open bar area
for riparian regeneration, it also
creates erosion hazards



FEDERAL EMERGENCY MANAGEMENT AGENCY

TECHNICAL SERVICES DIVISION
HAZARDS STUDY BRANCH



Cover: House hanging 18 feet over the Clark Fork River in Sanders County, Montana, after the river eroded its bank in May 1997. Photograph by Michael Gallacher.

As a result, we “discourage”
floodplain turnover



How Can We Manage Rivers as Corridors?



Sacramento River, California

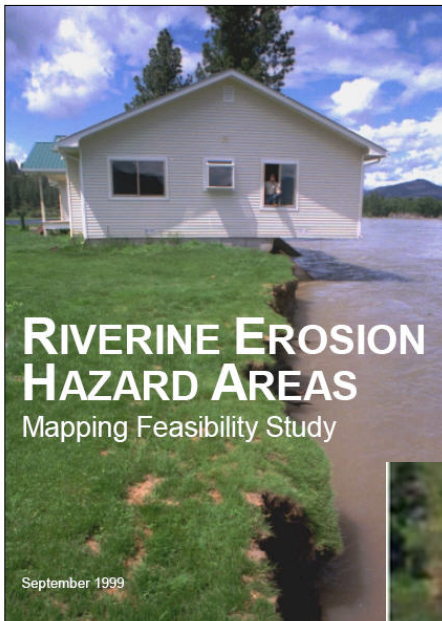


The Marias

How can we identify areas of high risk?



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The Clark Fork



The Yellowstone

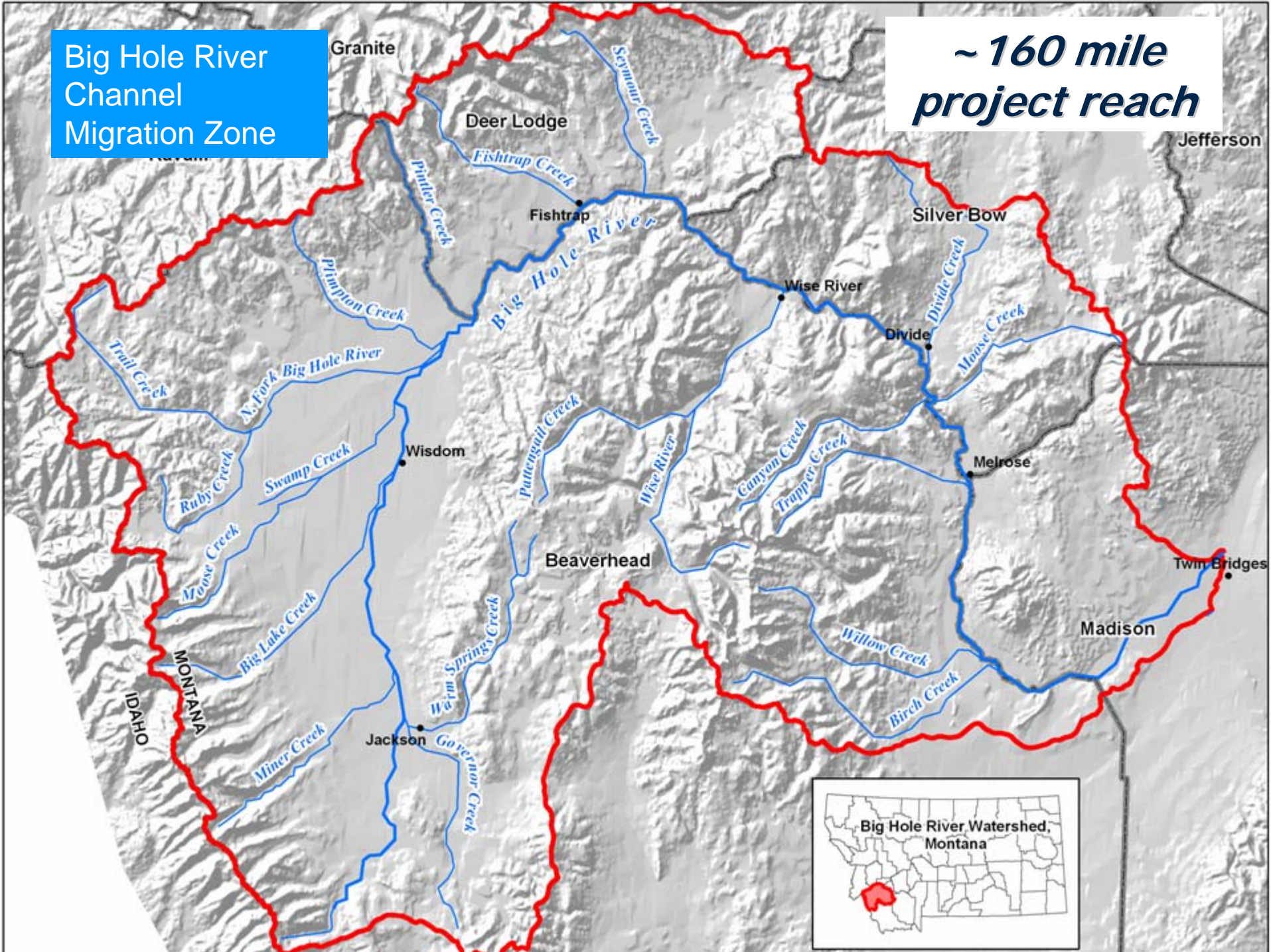
Channel Migration Zones (CMZ)

- Historic channel location (typically ~50 years)
- Buffer to allow for future migration



Big Hole River
Channel
Migration Zone

*~ 160 mile
project reach*



Big Hole CMZ

100-year Time Frame

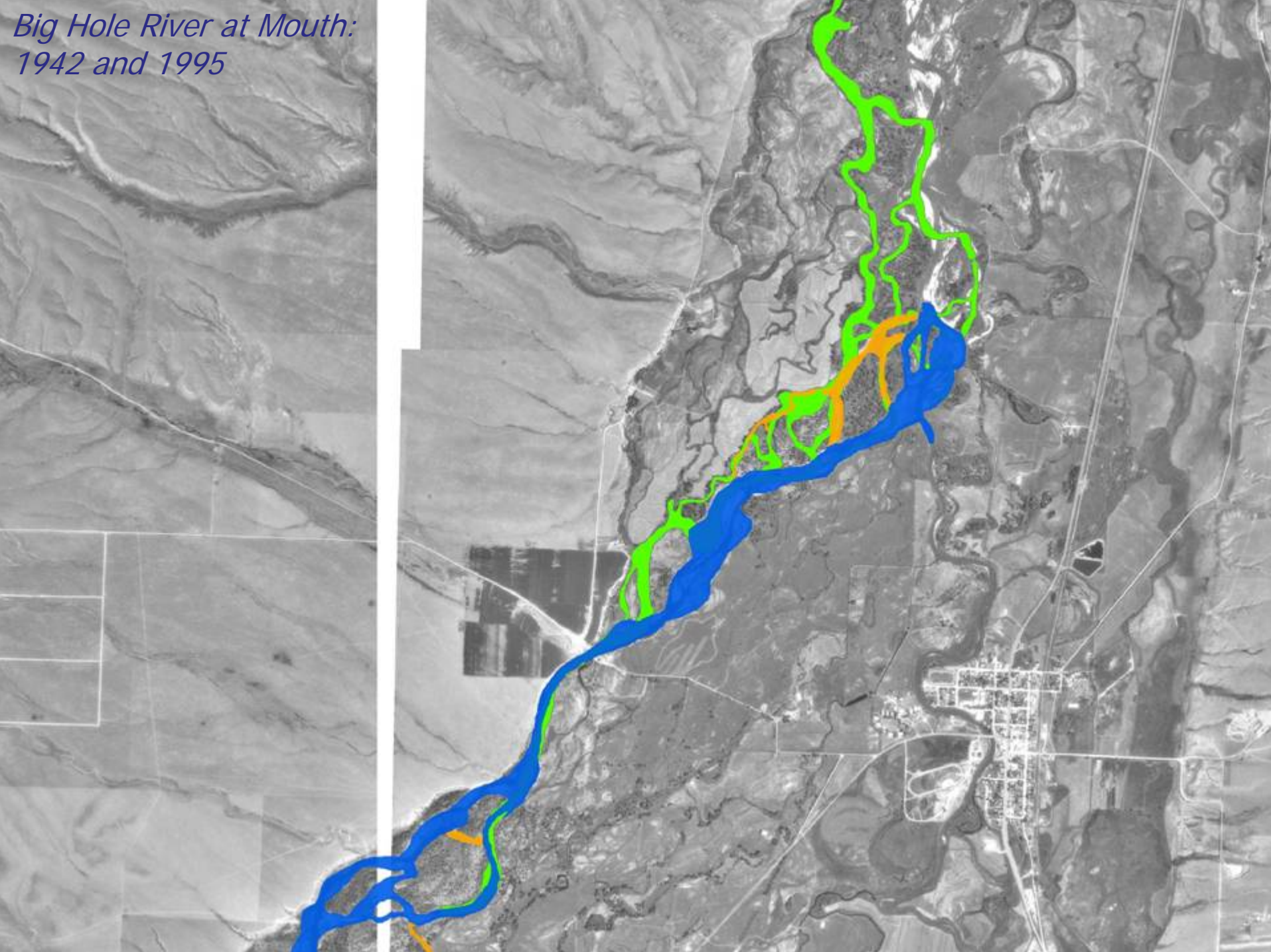
Big Hole River (52 Reaches):

- Historic channel locations
- 40 ft to 350 ft buffers based on measured erosion rate

*Big Hole River at Mouth:
1942*




*Big Hole River at Mouth:
1942 and 1995*





*Big Hole River at
Glen: 1942*



*Big Hole River at
Glen: 1942 and
1955*



*Big Hole River at
Glen: 1942, 1955,
and 1995*

Buffer width directly
reflects migration rate

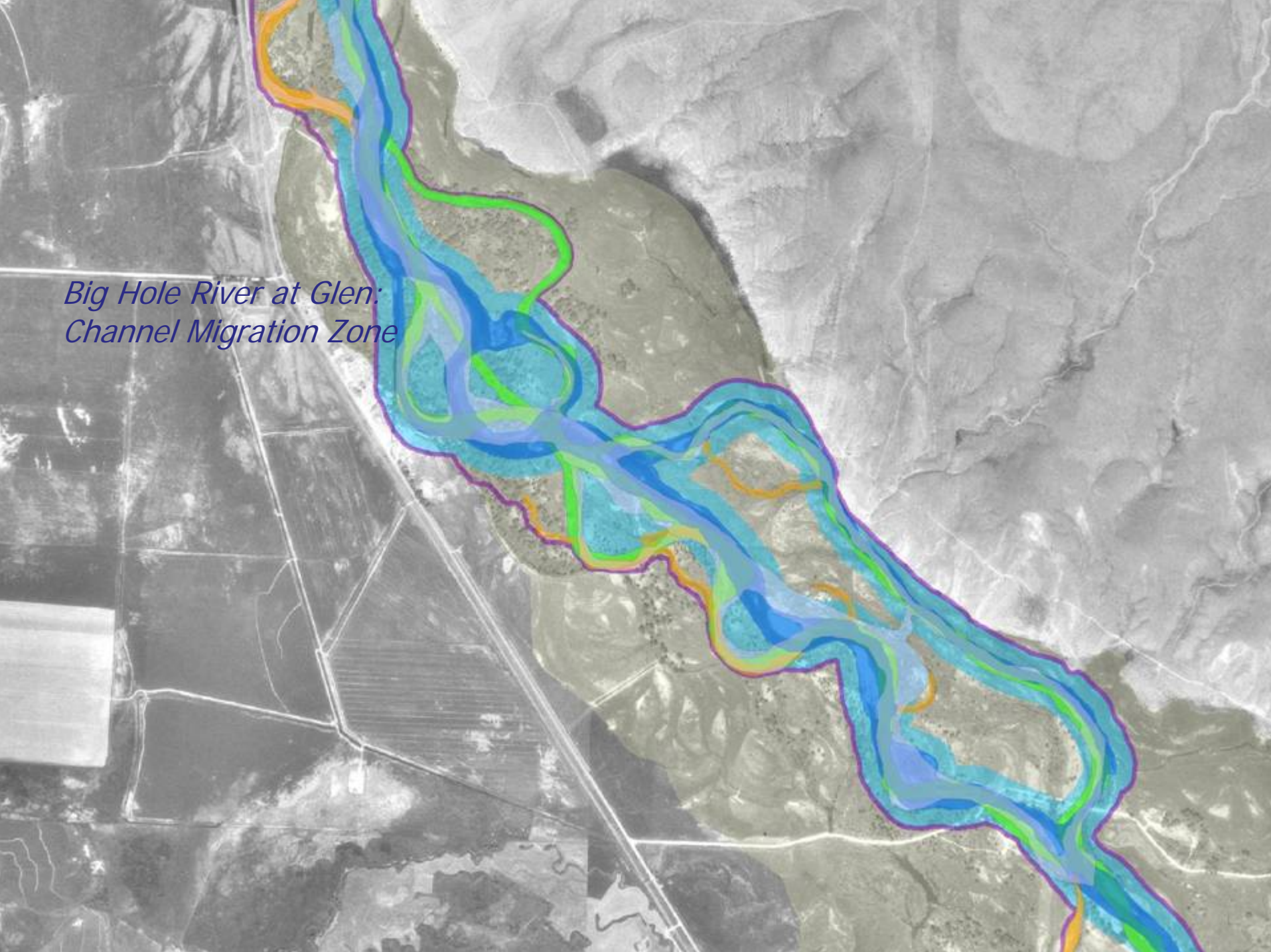


Wise River

*Douglas Creek,
Helmville*



*Big Hole River at Glen:
Channel Migration Zone*

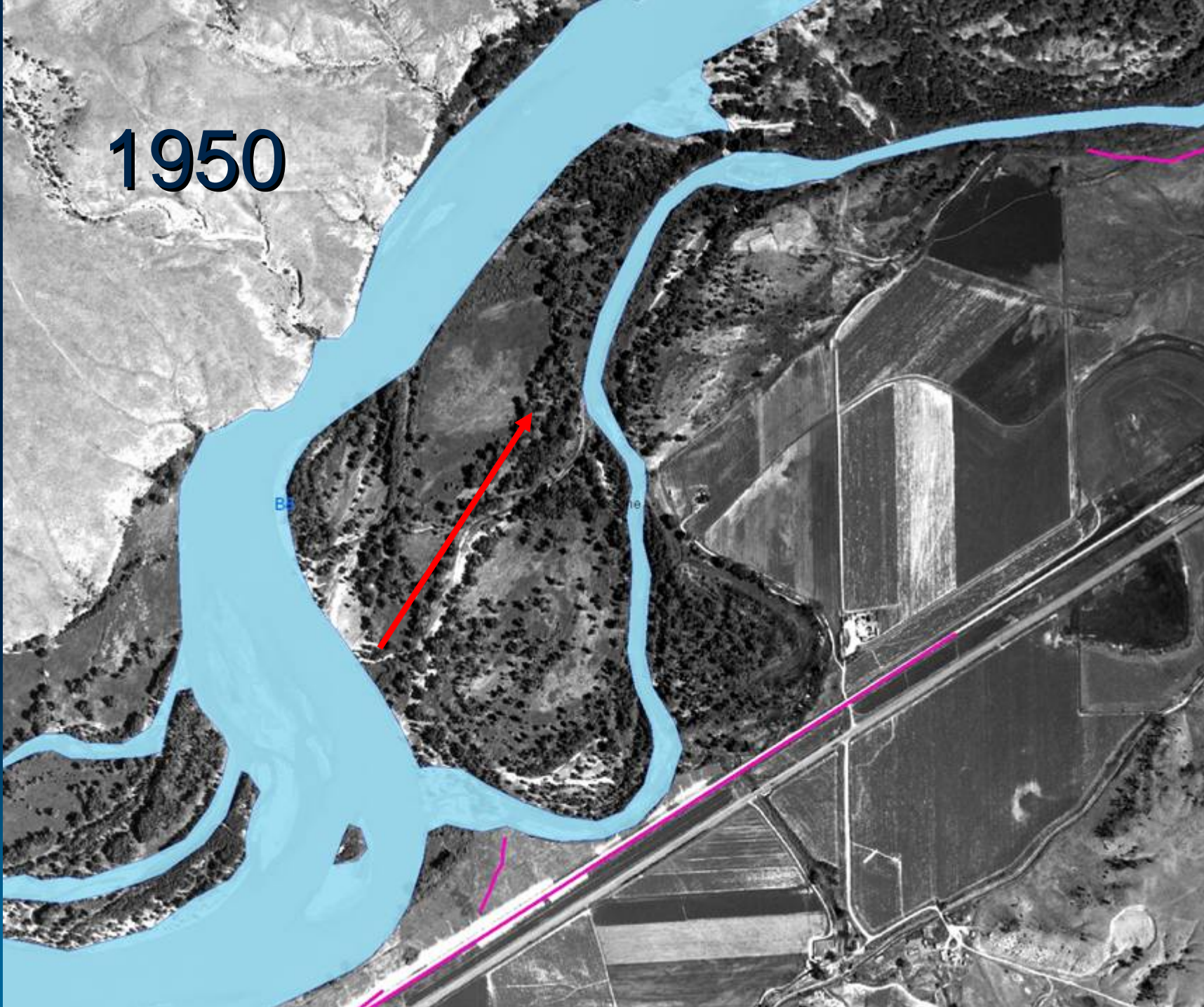


The Avulsion Potential Zone (APZ)

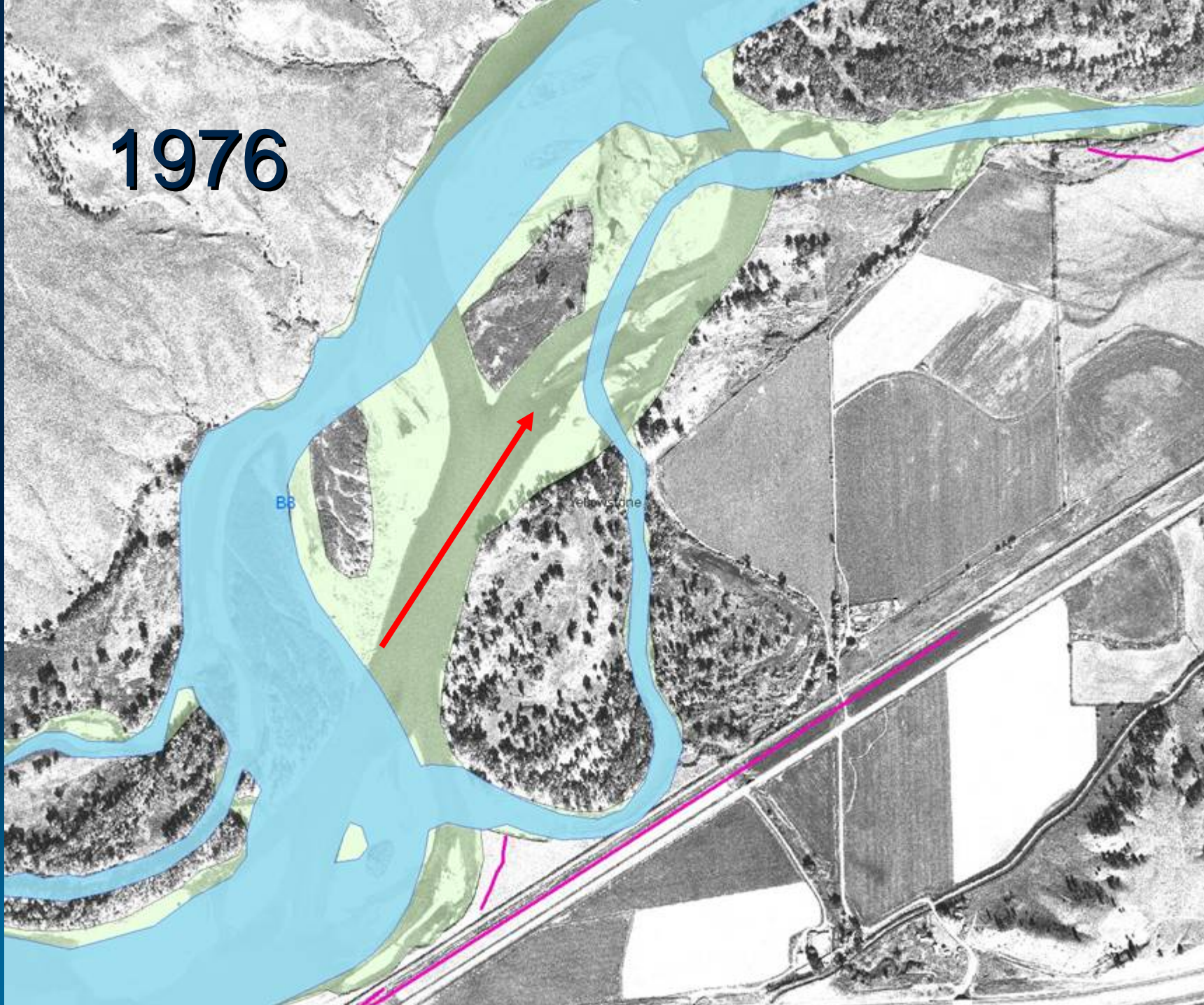


Secondary channels, relic channels and swales that are at risk of channel occupation

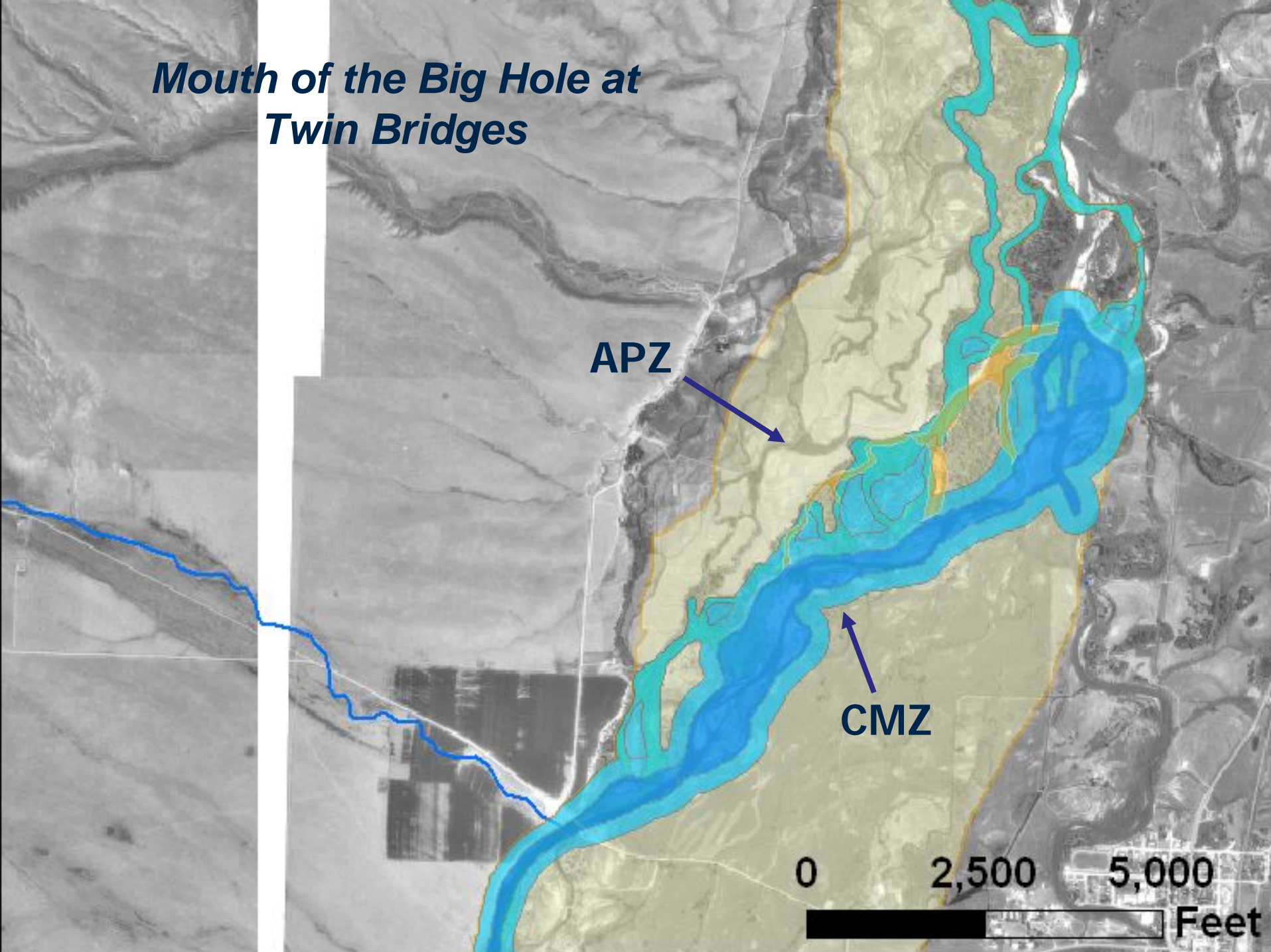
1950



1976

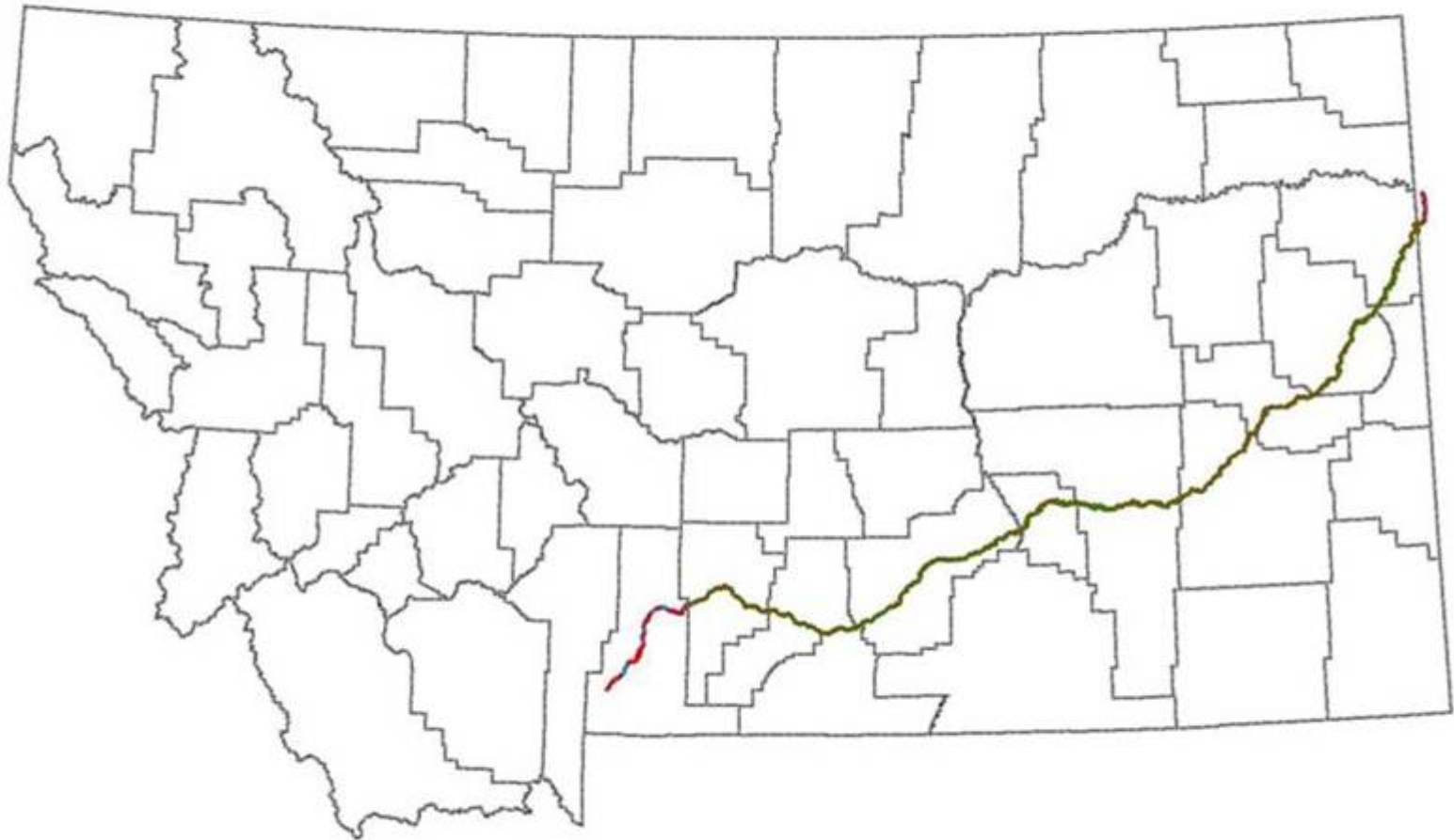


***Mouth of the Big Hole at
Twin Bridges***



Yellowstone River

477 Miles of CMZ in Review





1948-2005

Spring Creek Reach

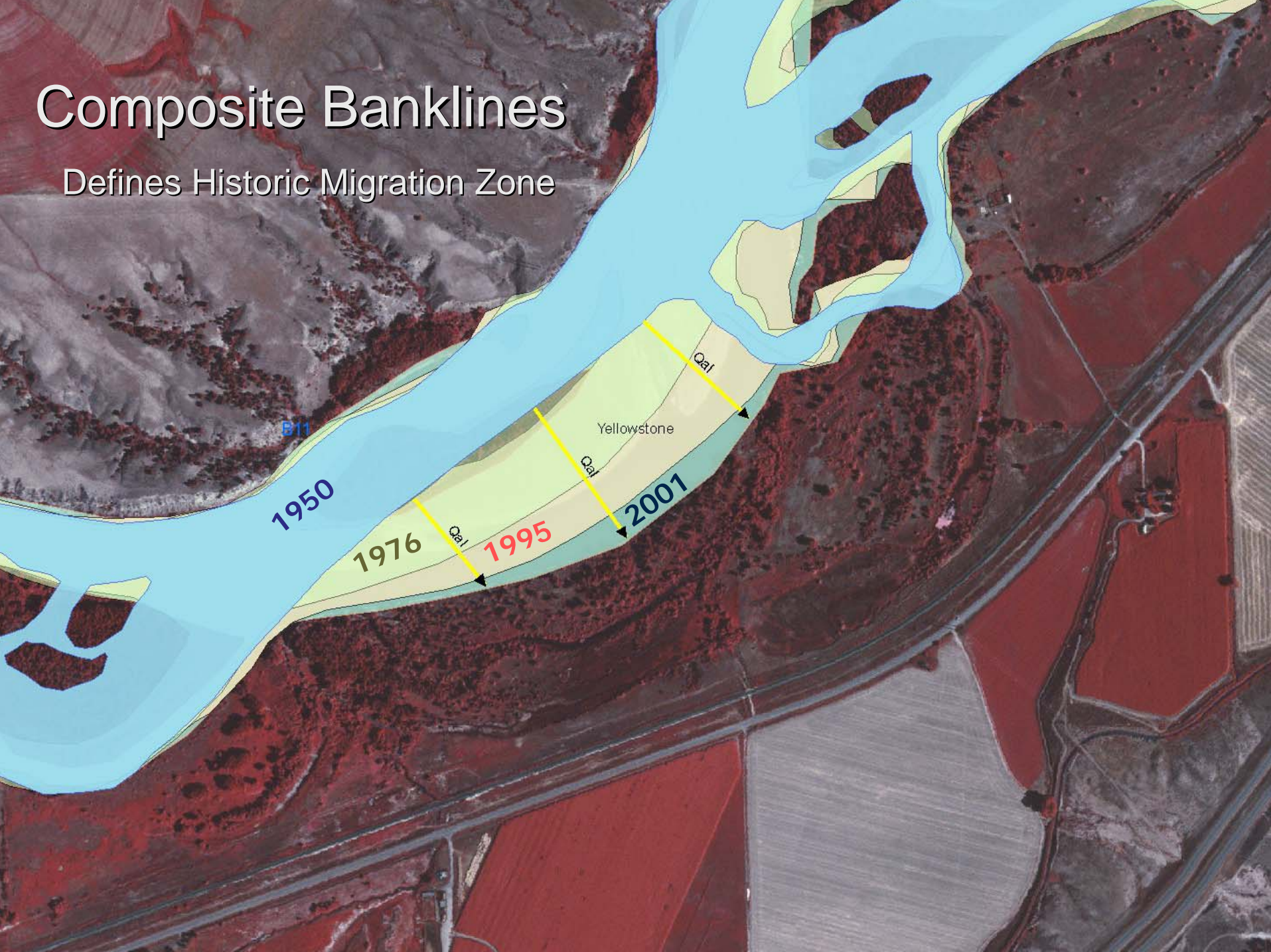
An aerial photograph of a river reach in Paradise Valley. A large section of the river and its immediate surroundings is highlighted in a semi-transparent blue color. The river flows from the top left towards the bottom right, featuring a prominent meander loop in the center. A thin, light-colored line, identified as a dike, runs parallel to the riverbank on the left side of the meander. The surrounding landscape is a mix of green forested areas and brownish agricultural fields. Some buildings and roads are visible in the upper left and lower right corners.

Dike →

*Spring Creek Reach
Paradise Valley*

Composite Banklines

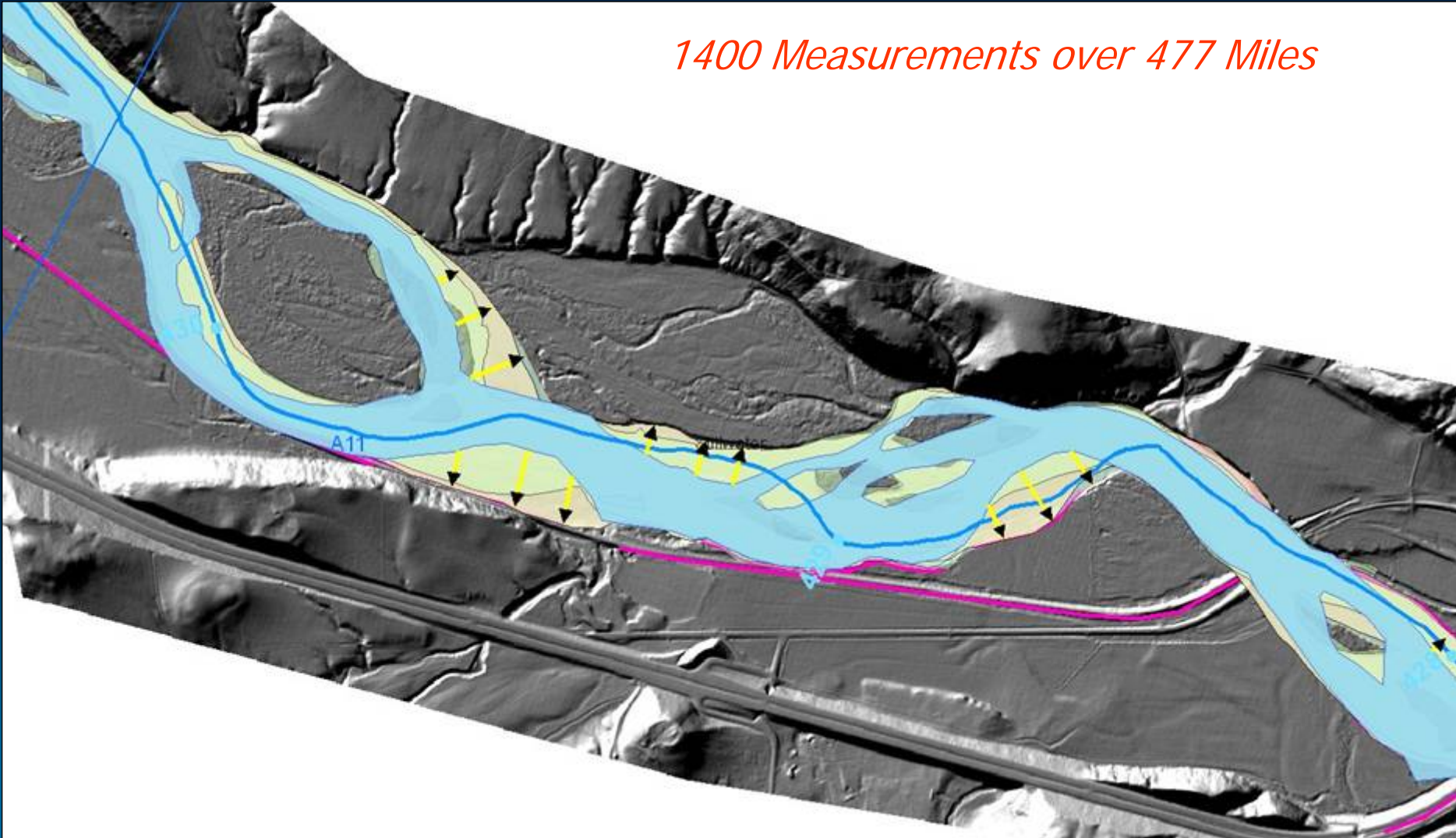
Defines Historic Migration Zone



Erosion Prone Area

Measure Migration Rates 1950-2001

1400 Measurements over 477 Miles



- Historic Migration Zone: 1948-2001
- Migration Distance: 1948-2001
- Banklines: 1948-1950
- Banklines: 1976-1977
- Banklines: 1995
- Banklines: 2001

126 feet

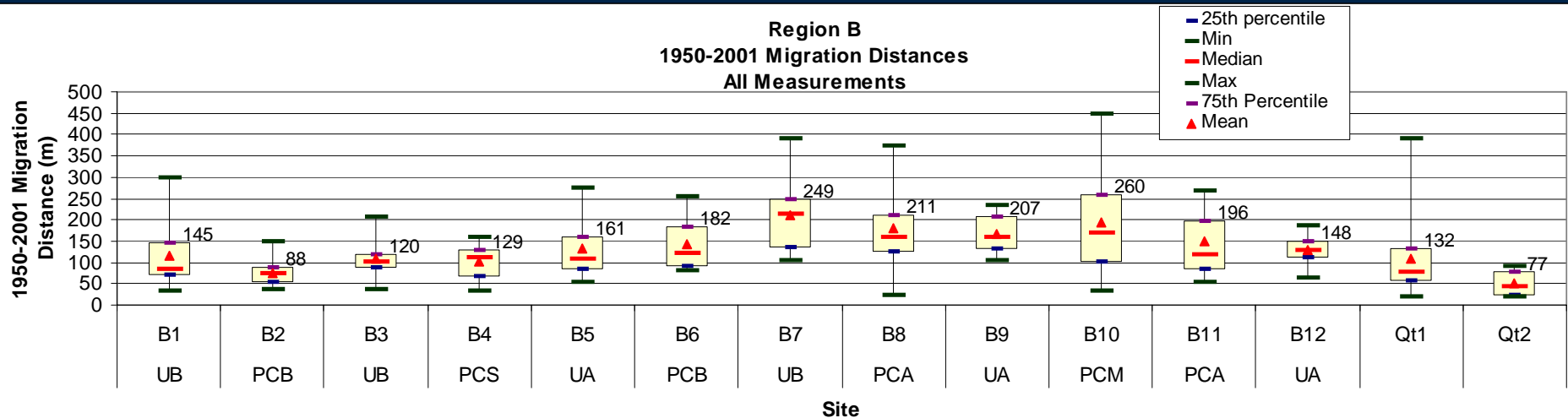
664 feet

201 feet

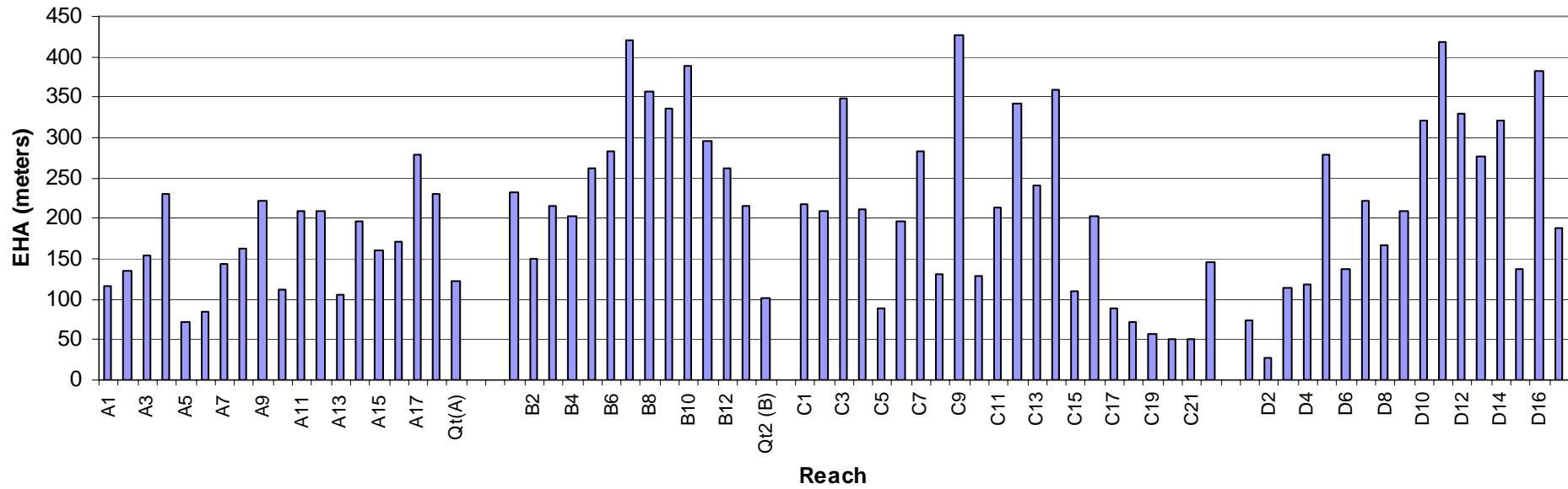
389 feet

127 feet

Calculate Reach Average

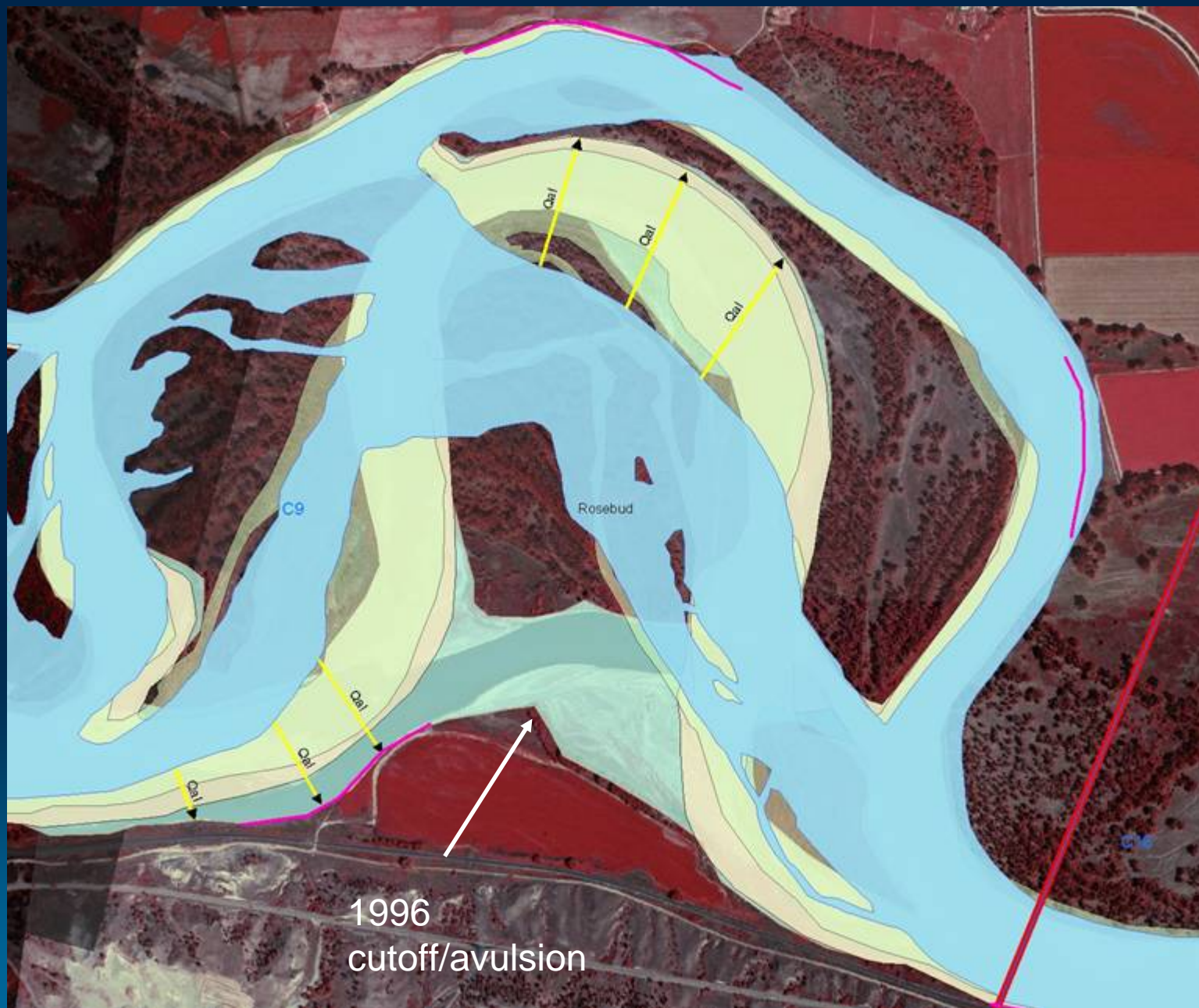


Buffer Widths



Composite CMZ





What about ice jams?



Montana Ice Jam Awareness Day

January 10, 2008

[MIJAD Home](#)

[Ice Types and Processes](#)

[Jam Types](#)

[Monitoring](#)



Great Links!

- [River Ice Types and River Ice Processes](#)
- [Jam Types](#)
- [Anchor ice and ice rafting pebbles video](#) (Courtesy Paul Heller, Prof. of Civil Engineering, Montana State University)
- [Cold Regions Research and Engineering Lab Ice Jam and Ice Safety](#)
- [Example of an ice jam affected hydrograph](#)

Report an Ice Jam

- [Montana Ice Jam Reporting Form](#)

Did you know...

Montana has the highest number of reported ice jams in the lower 48 states.
Montana has the highest number of ice jam related deaths in the lower 48 states.
Two-thirds of Montana's ice jams occur in February and March.

Locations of Ice Jams Reported in

How is our Ice Jam Awareness?

“Did you know”

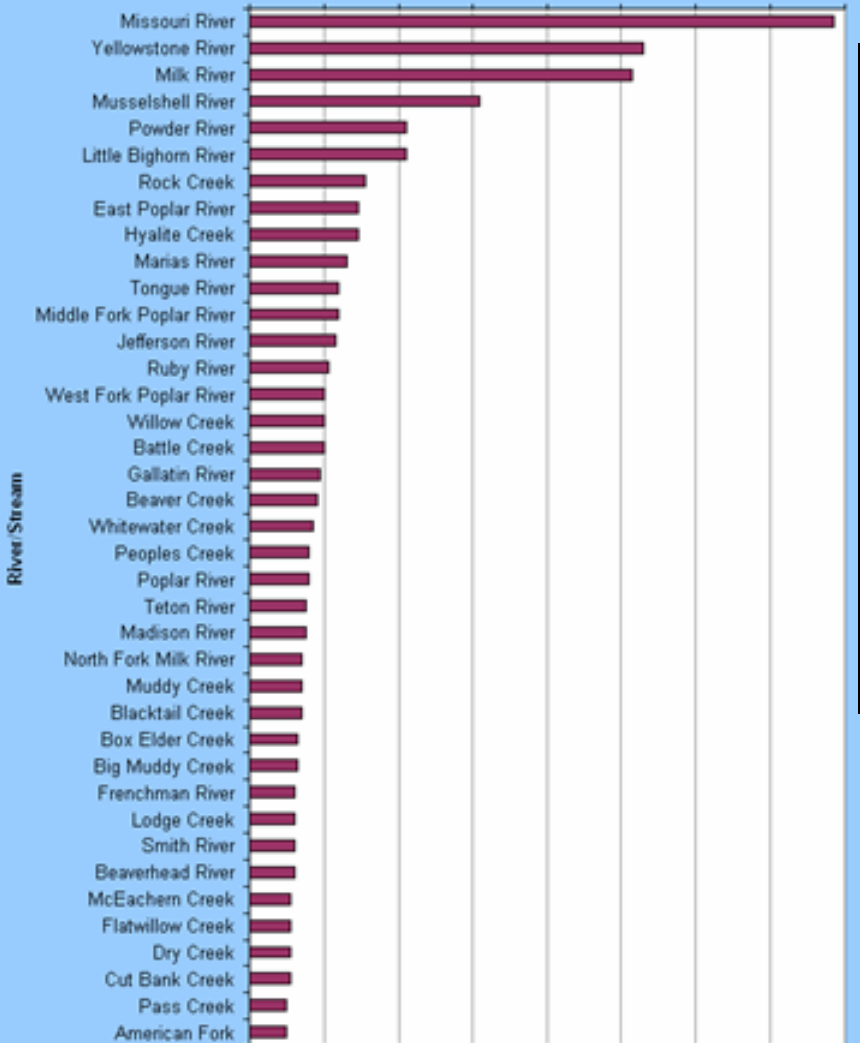
- There are 1476 Montana Ice Events documented in the Cold Regions Research and Engineering Lab (CREEL) Ice Jam Database
- This is 9% of the total for the US
- Jams typically form as ice accumulates at obstacles such as bends in rivers or bridge supports
- Water can quickly back up and cause localized flooding
- Jams can release quickly causing flash flooding



Streams East of Divide with 10 or More Reported Jams

Number of Jams

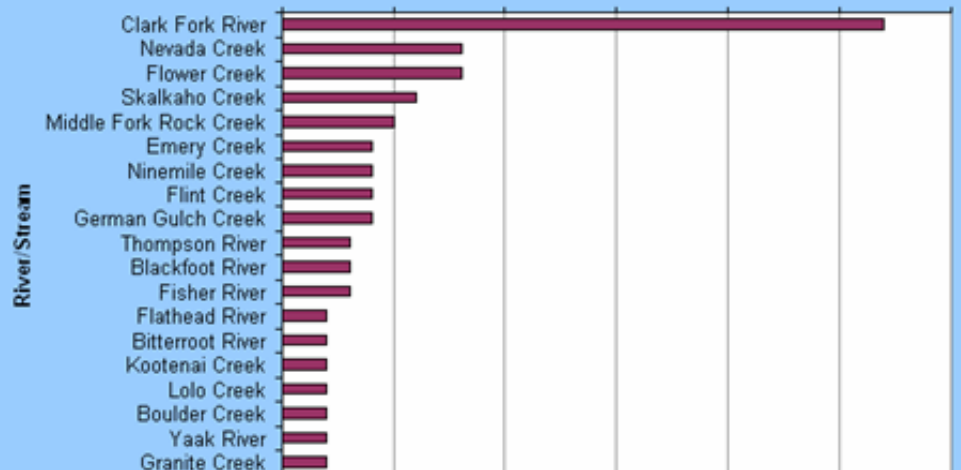
0 20 40 60 80 100 120 140 160



Streams West of Divide with 2 or More Reported Jams

Number of Jams

0 5 10 15 20 25 30



The Madison River at Ennis



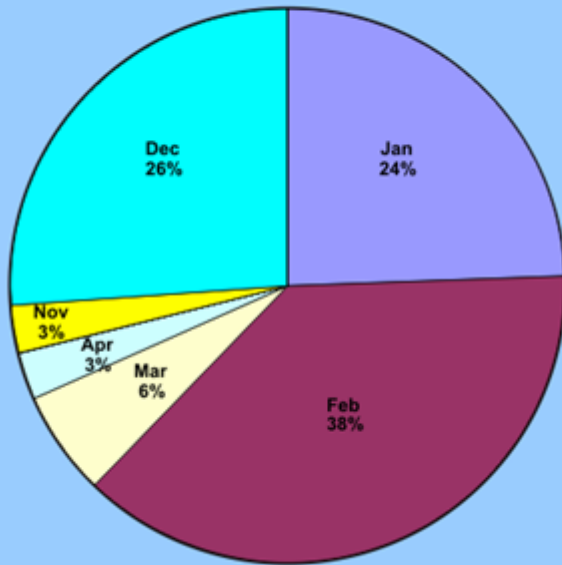
The Yellowstone River

Paradise Valley



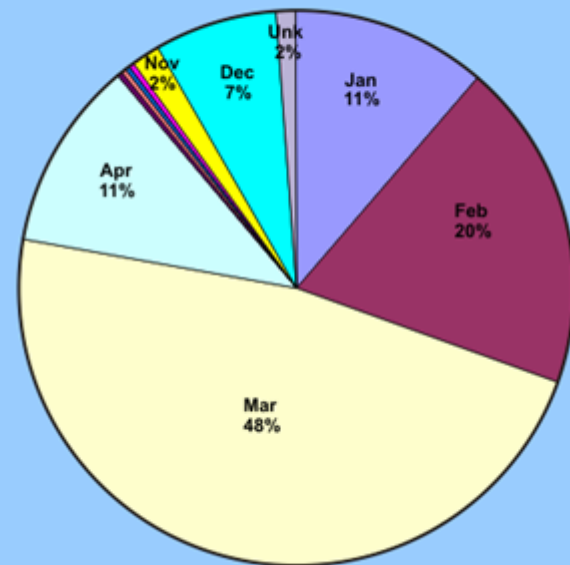
When do they tend to occur?

Percent of Reported Ice Events West of Divide by Month



West of Divide: Dec-Feb

Percent of Reported Ice Events East of Divide by Month



East of Divide: Feb-March

Pump Irrigation
System

Ice Jam
Caused Major
Cutoff



Image © 2008 DigitalGlobe
© 2008 Europa Technologies

© 2007 Google™

Missouri near Culbertson

Floodplain Processes

- Hydrologic Buffering
- Sediment Cycling
- Considerations
 - Isolation
 - Irrigation
 - Climate
 - Beaver
 - Erosion Risk
 - Flood Risk
 - Ice Jamming/Catastrophic Disturbance



“If you’re going to live by the river, make friends
with the crocodile”

---Indian proverb



*East Gallatin
River*

*Mississippi River
Floodplain*

